100-lbf LO_2/CH_4 RCS Thruster Testing & Validation

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Meet The Engine

•100 pound thrust liquid Oxygen-Methane thruster sized for RCS (Reaction Control System) Applications

Innovative Design Characteristics

•Simple compact design with minimal part count
•Gaseous or Liquid propellant operation
•Affordable and Reusable
•Greater flexibility than existing systems
•Part of NASA'S study of "Green Propellants"

Test Stand/Thruster Preparation

• Installed new main propellant valves (Valvetech)

• Calibrated and installed new pressure transducers (Statham)

• Leak checked Actuation/Purge Systems with GN_2

• Installed stand at test site with camera coverage

• Leak checked Fuel/Oxidizer Systems with LN_2

DAQ/Instrumentation Verification

• Checked DAQ System for proper/consistent excitation and actuation

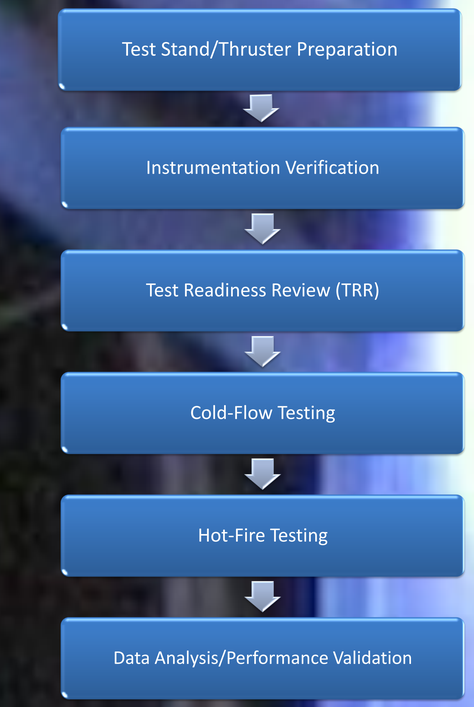
• Wiring checked for continuity and proper operation with valves, transducers, and thermocouples

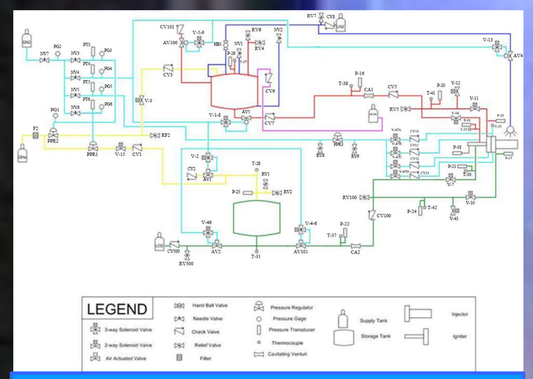
• Calibrated pressure transducers both out of system and installed in system

• Thermocouple inputs checked with Thermocouple Calibrator

• Tested valves for proper actuation

Procedural Flow Chart





Thruster Schematic

SBIR Phase I Hot-Fire Test

Future Applications & Benefits

• Spacecraft/Launch Vehicle Attitude Control Systems (ACS)

• In-Situ Utilization of CH_4 on Mars for potential propellant usage

• Environmentally-Friendly exhaust products

Cold-Flow Test/Hot-Fire Simulation

• Dry run walkthrough of procedures and documentation

• Hot-fire test simulation conducted with LN_2 as replacement for LO_2 and LCH_4

• Full test simulation included:
  - Step-by-step operations according to procedures
  - Design and verification of test/safe sequences
  - Control of test stand through Labview GUI
  - Tracking of test operations and conditions
  - Interaction with test technician for safe operation of test stand

Hot-Fire Testing/Data Analysis

• Hot-fire testing will validate performance and functionality of thruster

• Thruster's dependence on mixture ratio will be assessed

• Data will be compared with previous test results to verify reliability and repeatability

• Data will be used to calculate performance parameters such as thrust and ISP

Tentative Test Matrix

Test #	Description	Duration (s)	Injector Propellant Supply	Igniter Propellant Supply	Ox Mdot (lbm/s)	Fuel Mdot (lbm/s)	O/F	Description
1	Sparker	0.1	-	-	-	-	-	Ensure sparker
2	Igniter Cold Flow	0.1	-	LN2	0.01000	0.00667	1.50	Cold Flow Igniter Test
3	Igniter Cold Flow	0.1	-	LN2	0.01000	0.00588	1.70	Cold Flow Igniter Test
4	Igniter Cold Flow	0.1	-	LN2	0.01000	0.00526	1.90	Cold Flow Igniter Test
5	Thruster Cold Flow	2	LN2	LN2	0.20000	0.13333	1.50	Cold Flow Injector Test
6	Thruster Cold Flow	2	LN2	LN2	0.16600	0.09790	1.70	Cold Flow Injector Test
7	Thruster Cold Flow	2	LN2	LN2	0.20000	0.10526	1.90	Cold Flow Injector Test
8	Igniter	0.1	-	Liquid	0.01000	0.00667	1.50	Cryo Propellant Supply
9	Igniter	0.1	-	Liquid	0.01000	0.00588	1.70	Cryo Propellant Supply
10	Igniter	0.1	-	Liquid	0.01000	0.00526	1.90	Cryo Propellant Supply
11	Thruster	2	Liquid	Liquid	0.20000	0.13333	1.50	Cryo Propellant Ignition Test
12	Thruster	2	Liquid	Liquid	0.16600	0.09790	1.70	Cryo Propellant Ignition Test
13	Thruster	2	Liquid	Liquid	0.20000	0.10526	1.90	Cryo Propellant Ignition Test

Tentative Test Matrix